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None

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(54) Improvements in or relating to bicycles or tricycles

(57) A bicycle wheel has a hub with a casing 14 enclosing an electric motor in the form of a low voltage DC flat motor. The motor has an armature 24 co-operating with an annular magnetic pole member 26 which is attached to the casing 14 and which rotates with the wheel. The armature 24 drives the pole member 26 through reduction gearing comprising an eccentric 32 and an externally toothed gear 36 which meshes with an internal ring gear 38 bonded to the inside of the casing 14. The motor is energised by a 12 volt battery carried on the bicycle, and the motor acts to provide drive additional or alternative to that produced by the bicycle rider.

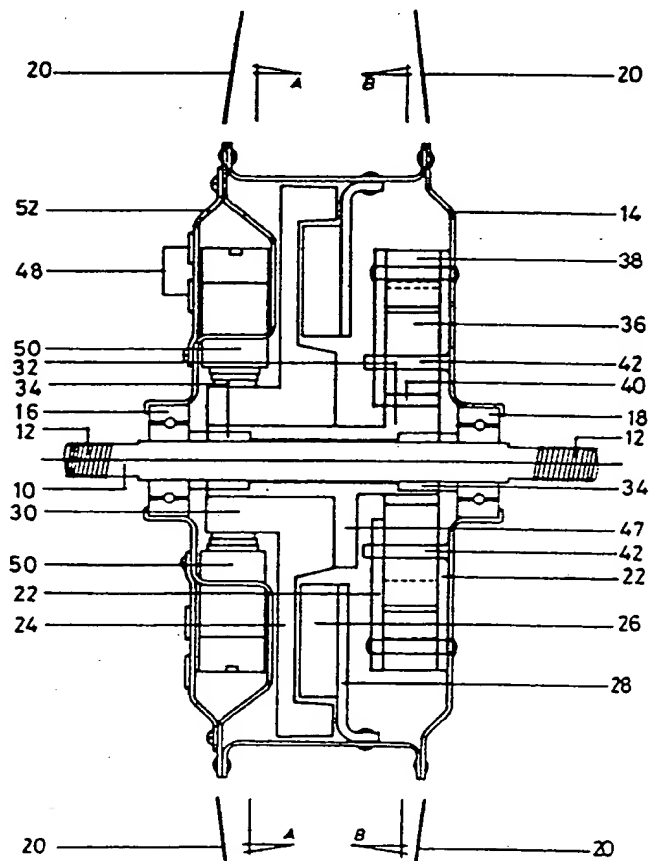


Fig. 1

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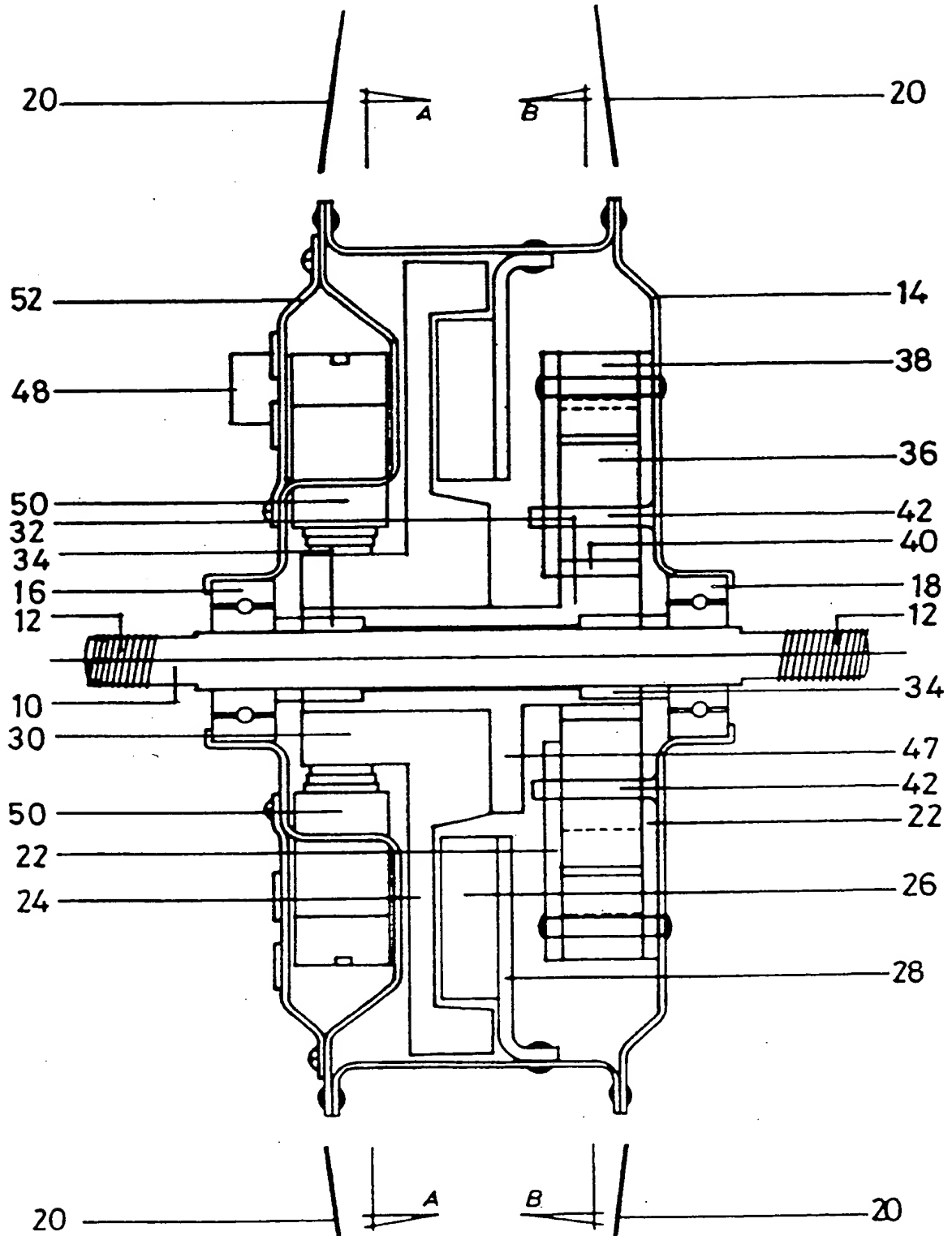


Fig.1

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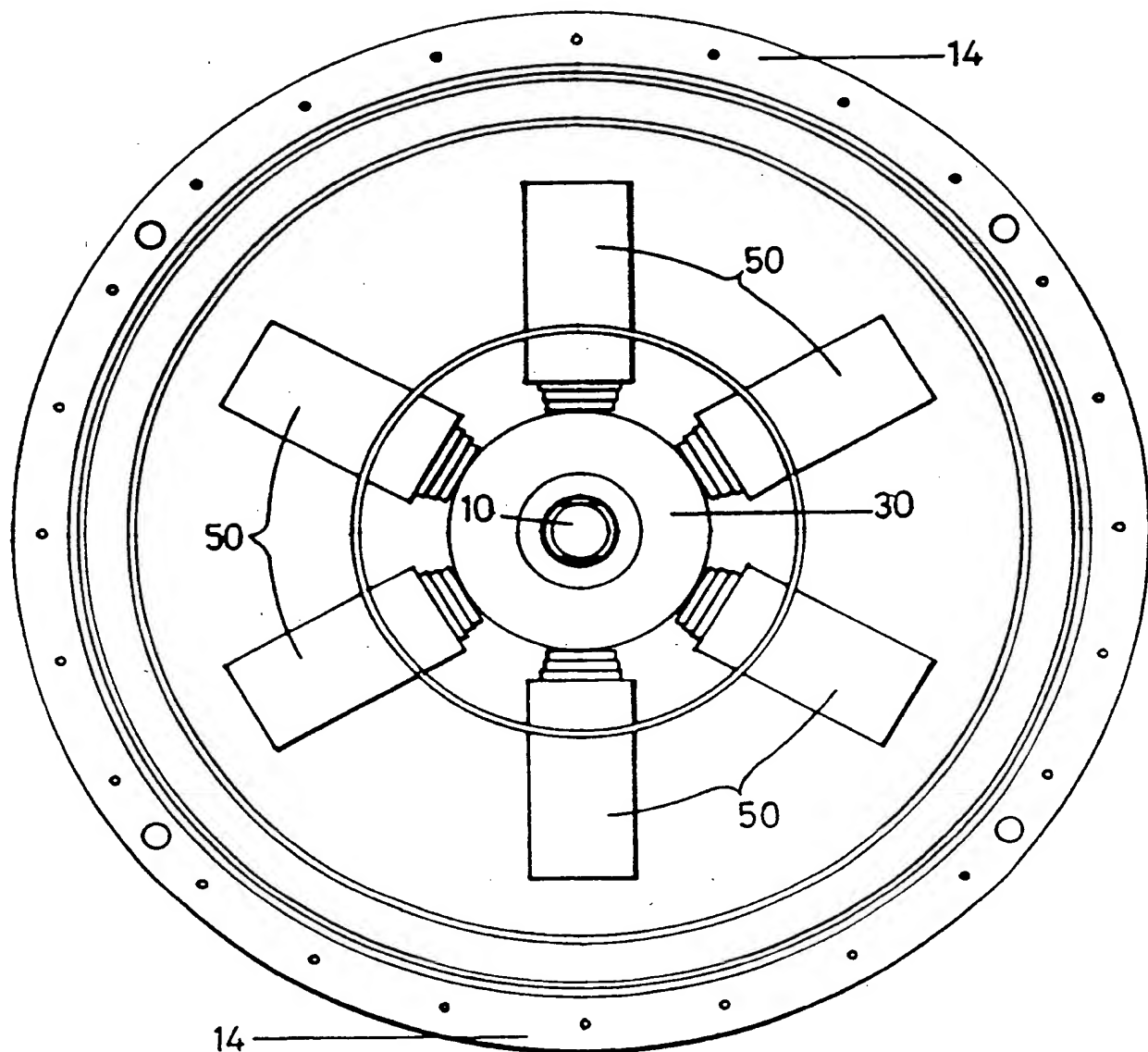


Fig. 2

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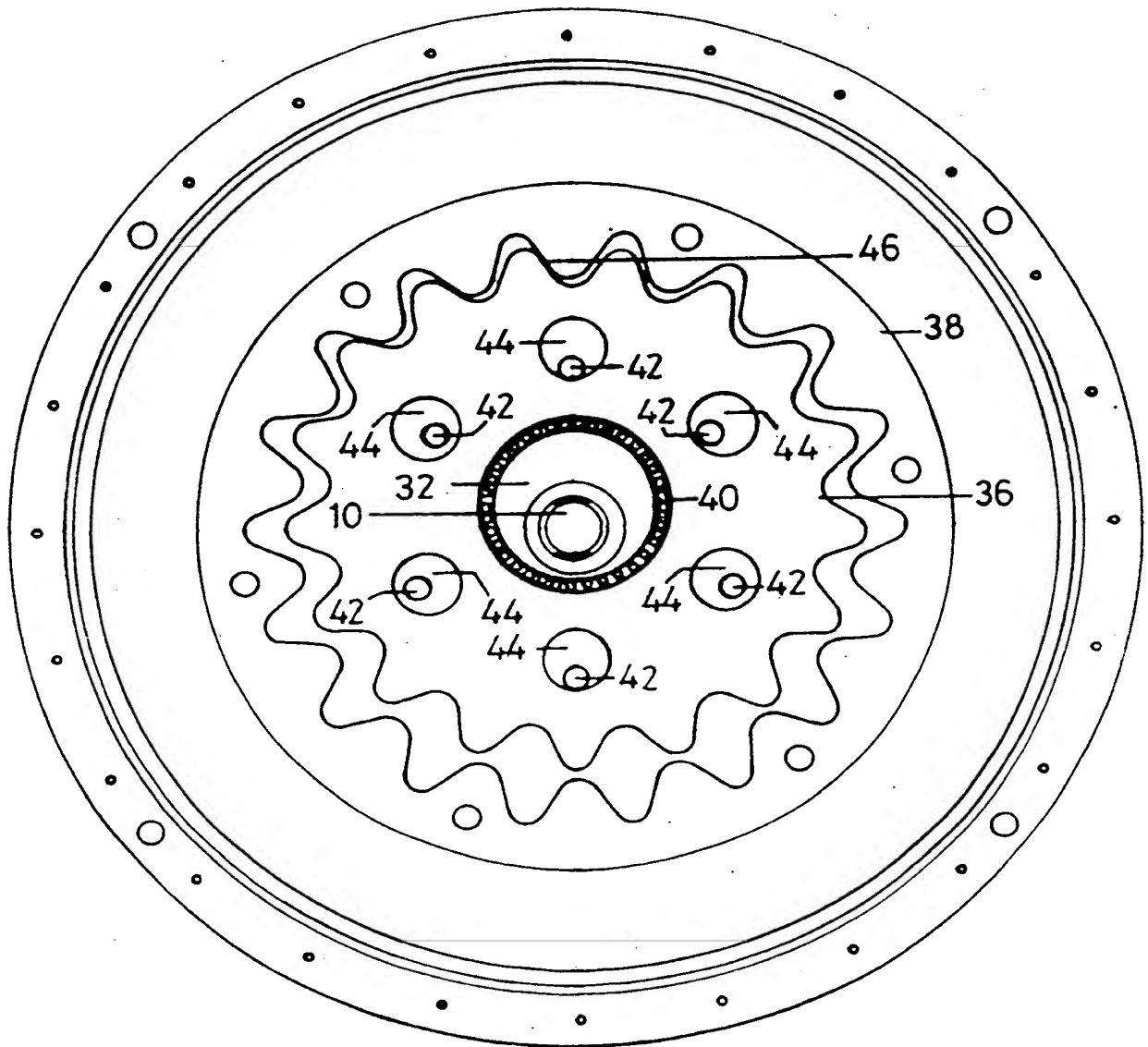


Fig.3

SPECIFICATION

Improvements in or relating to bicycles or tricycles

Field of the Invention

5 This invention relates to bicycles or tricycles and aims to provide drive from an electric motor to supplement the tractive effort produced by the rider. The term bicycle or tricycle is intended to cover any pedal cycle.

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Background to the Invention

Bicycles with electric motors providing supplementary drive are known. However, the motors have been in the nature of add-on units which have been cumbersome and visually unattractive.

Summary of the Invention

According to the invention a bicycle or tricycle has an electric motor which is disposed in a hub of one of the wheels of the bicycle or tricycle and which is operative to drive said one wheel to supplement the tractive effort produced by the rider of the bicycle or tricycle, wherein the motor is a low voltage DC motor having an annular armature and an annular magnetic pole member, the armature and pole member being rotatable in the same direction and at differing speeds with respect to an attachment member for mounting the motor in the bicycle or tricycle.

Such motors are compact and efficient and can be accommodated in the limited confines of the hub. The motor is preferably a 12 volt DC motor, in which case the bicycle or tricycle will carry a 12 volt battery to power the motor.

The preferred embodiment is a bicycle in which the rear wheel hub is modified in order to accommodate the electric motor, but alternatively the front wheel hub may accommodate the electric motor. It is also possible for both the front and rear wheel hubs of a bicycle to be fitted with electric motors.

The hub may include a casing which rotates with the wheel and which surrounds and protects the motor.

The motor preferably rotates at a high speed, e.g. 3000 rpm, in order to operate within its most efficient speed range. A bicycle travelling at 15 miles an hour typically has its wheels rotating at 200 revolutions per minute, so there is preferably a reduction gearing mechanism between the armature and the casing. This reduction gearing mechanism may comprise an externally toothed gear rotatably driven by the armature through the intermediary of an eccentric, and an internal ring gear which is attached to the casing and with which the externally toothed gear meshes. Alternative gearing mechanisms are possible, e.g. variable speed by belts, friction drive or the like.

The motor may drive the wheel through a uni-directional drive mechanism which allows the motor to drive the wheel but which prevents the wheel driving the motor.

The bicycle or tricycle preferably has a speed-sensitive device which is sensitive to the rotational

speed of the wheels and which prevents actuation of the motor below a predetermined threshold speed, such as five miles per hour. Hence, in use the rider provides the tractive effort to start moving forward and when the threshold speed is exceeded he may operate a manually actuatable switch in order to energise the motor to provide a drive to the corresponding wheel, which may be alternative to but is preferably additional to the tractive effort produced by the rider. The manually actuatable switch may be in the nature of a throttle control, providing a progressively increasing amount of electric power to the motor, to give variable speed control.

80 The hub of the rear wheel of a bicycle forming a preferred embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:—

Figure 1 is a cross-sectional view through the hub, Figure 2 is a sectional view on the line A—A of Figure 1, and

Figure 3 is a sectional view on the line B—B of Figure 1.

90 Detailed Description of the Drawings

Referring to Figure 1, the hub has a central spindle 10 which has threaded ends 12 to receive nuts (not shown) for securing the spindle in the rear frame on the bicycle. Hence, the spindle 10 does not rotate. A casing 14, pressed from metal, is rotatably mounted on the spindle 10 by means of spaced bearings 16, 18. The radially outermost edges of the casing 14 are attached to the spokes 20 of the wheel. The casing 14 is attached to a drive sprocket (not shown) around which passes the usual chain (not shown) through which tractive effort is transferred from the bicycle pedals to the rear wheels.

The casing 14 encloses and protects an electric motor which is a 1/3 horse power, 12 volt DC disc motor having an annular armature 24 co-operating with an annular magnetic pole member 26. The pole member 26 is supported by an annular bracket 28 from the casing 14, and hence the pole member 26 rotates with the casing 14. The armature 24 is attached to a commutator 30 and to an eccentric 32, the assembly of armature 24, commutator 30 and eccentric 32 being rotatably mounted on the spindle 10 through the intermediary needle roller bearings 34.

115 The eccentric 32 is surrounded by an externally toothed gear 36 best shown in Figure 3. The gear 36 meshes with an internal ring gear 38 secured (e.g. by riveting) to the inside of the casing 14. The gear 36 is supported on the eccentric 32 by means of a uni-directional drive mechanism in the form of a needle roller clutch bearing 40.

The roller clutch bearing 40 prevents the gear 36 from rotating about the central axis of the spindle 10, but allows the gear 36 an oscillatory or gyratory motion as the eccentric 32 rotates on the spindle 10. Six pins 42 project internally from the casing 14 and extend through respective oversize bores 44 (Figure 3) in the gear 36. Should the bearing 40 fail, the pins 42 and bores 44 will act as a back up to prevent the gear 36 from rotating about the central axis of the

spindle 10, but still allow the gear 36 the oscillatory or gyratory motion as the eccentric 32 rotates on the spindle 10.

The gear 36 is located between two spaced plates 22 (Figure 1) which are attached to the casing 14 and which allow the gear 36 to undergo its wobbling motion between them.

As a result, the gear 36 drives the ring gear 38, the region of contact 46 between the gear 36 and 38 moving around the periphery of the gear 36 as the latter undergoes its gyrating action. There is a reduction in the ratio of eighteen to one between the rotational speeds of the commutator 30 and the ring gear 38. A weight 47 counterbalances the eccentric 32.

Electrical power from a battery carried on the bicycle is lead into the motor by annular pick up contacts 48 on the left hand side of the casing 14 as viewed in Figure 1. Electrical current from the contacts 48 is led by six equi-angularly spaced brushes 50 (Figure 2) to the commutator 30. By this means electrical power is lead from the battery to the commutator 30, and this supply is maintained when the commutator 30 rotates on the spindle 10.

The casing 14 has a removable cover 52 which allows access to the brushes 50 for maintenance.

The armature 24 has windings which extend around the complete periphery of the armature and are, in effect, coils flattened into the plane of the armature 24.

Power from the battery to the motor is taken through two switches, namely a speed-sensitive device and a manually operable switch positioned e.g. on the handlebar for ease of operation by the rider. The speed-sensitive device is such that the motor cannot be energised unless the bicycle is travelling at a speed in excess of a threshold speed such as 5 miles an hour. In excess of this speed, the rider may operate the manually operable switch in order to energise the motor to provide power assistance. Below 5 miles an hour the manually operable switch has no effect. The roller clutch bearing 40 ensures that the casing 14 does not drive the motor in the reverse direction, which would cause resistance to rotation and cause the motor to act as a generator.

It will be appreciated that in use the assembly of commutator 30, armature 24 and eccentric 32 rotate at high rotational speed, e.g. 3000 rpm, with respect to the spindle 10 which does not rotate. The gear 36 transmits motion to the casing 14 which rotates in the same direction as the commutator armature 24, the casing 14 rotating at a slower speed, typically 200 rpm.

CLAIMS

1. A bicycle or tricycle having an electric motor which is disposed in a hub of one of the wheels of the bicycle or tricycle and which is operative to drive

60 said one wheel to supplement the tractive effort produced by the rider of the bicycle or tricycle, wherein the motor is a low voltage DC motor having an annular armature and an annular magnetic pole member, the armature and pole member being 65 rotatable in the same direction and at differing speeds with respect to an attachment member for mounting the motor in the bicycle or tricycle.

2. A bicycle or tricycle according to claim 1, wherein the hub of said one wheel includes a casing 70 which rotates with the wheel and which surrounds and protects the motor.

3. A bicycle or tricycle according to claims 2, wherein the pole member is attached to, and rotates with, the casing.

4. A bicycle or tricycle according to claim 3, wherein the armature drives the pole member through reduction gearing.

5. A bicycle or tricycle according to claim 4, wherein the reduction gearing comprises an 80 externally toothed gear rotatably driven by the armature, through the intermediary of an eccentric, and an internal ring gear which is attached to the casing and with which the externally toothed gear meshes.

6. A bicycle or tricycle according to any of the preceding claims, wherein the motor drives the wheel through a uni-directional drive mechanism which allows the motor to drive the wheel but which prevents the wheel driving the motor.

7. A bicycle or tricycle according to claims 5 and 6, wherein the uni-directional drive mechanism is a clutch bearing disposed in the drive train between the armature and the pole member.

8. A bicycle or tricycle according to claims 5 and 7, 95 wherein the clutch bearing is disposed between the eccentric and the externally toothed gear.

9. A bicycle or tricycle according to any of the preceding claims, wherein the armature is rotatably mounted on a spindle which constitutes said 100 attachment member and which is arranged to be non-rotatably mounted in a frame member of the bicycle or tricycle.

10. A bicycle or tricycle according to any of the preceding claims, wherein the motor has brushes 105 which rotate with the casing and which lead electrical power to a commutator rotatable with the armature.

11. A bicycle or tricycle according to claim 10, wherein the casing has removable portion or 110 portions to provide access to the brushes.

12. A bicycle or tricycle according to any of the preceding claims and having a speed-sensitive switch operative to prevent energisation of the motor below a threshold speed of travel of the 115 bicycle or tricycle.

13. A bicycle hub constructed and arranged substantially as herein particularly described with reference the accompanying drawings.

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